R.B. WITTE Jr.

TECHNICAL ORDER NO. 30-100A-2

INSTRUCTORS' SYLLABUS

INSTRUMENT FLYING

Basic

15 DECEMBER 1944

RESTRICTED

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BASIC INSTRUCTORS' SYLLABUS

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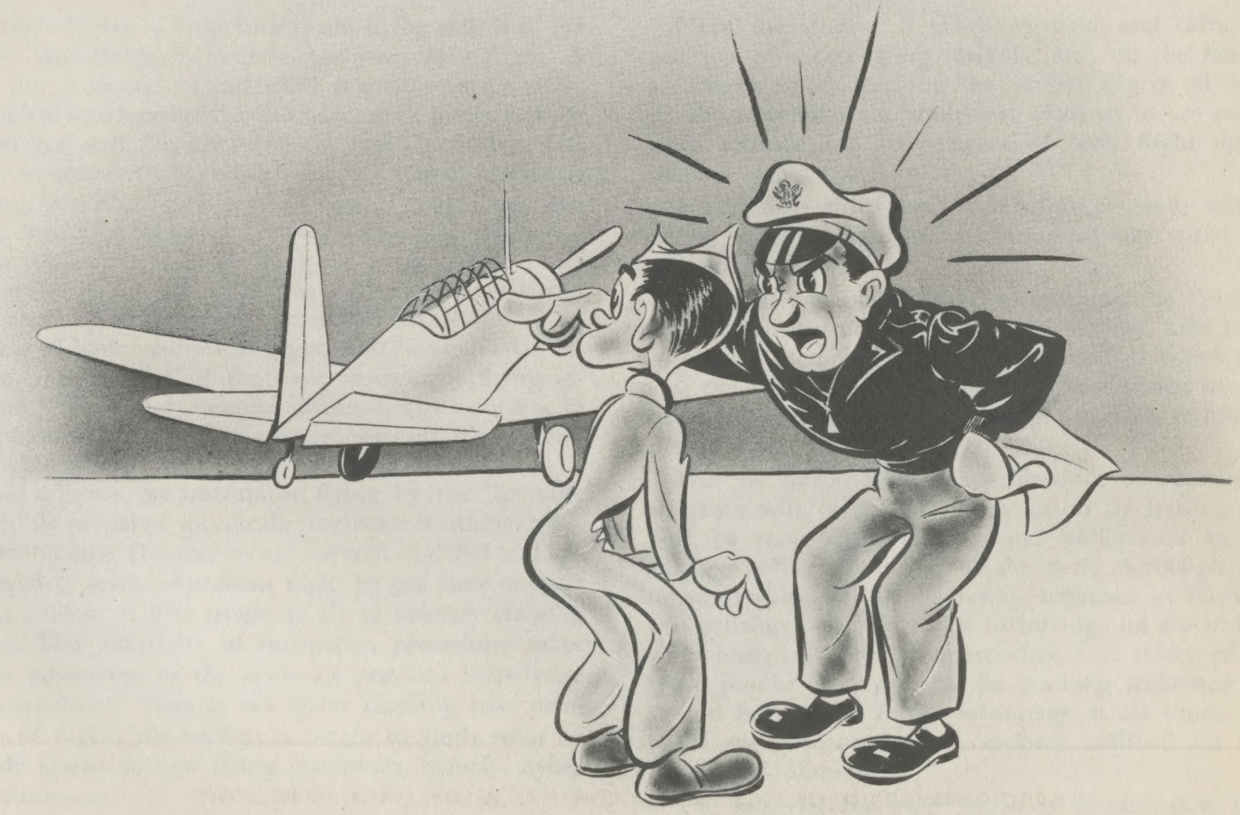
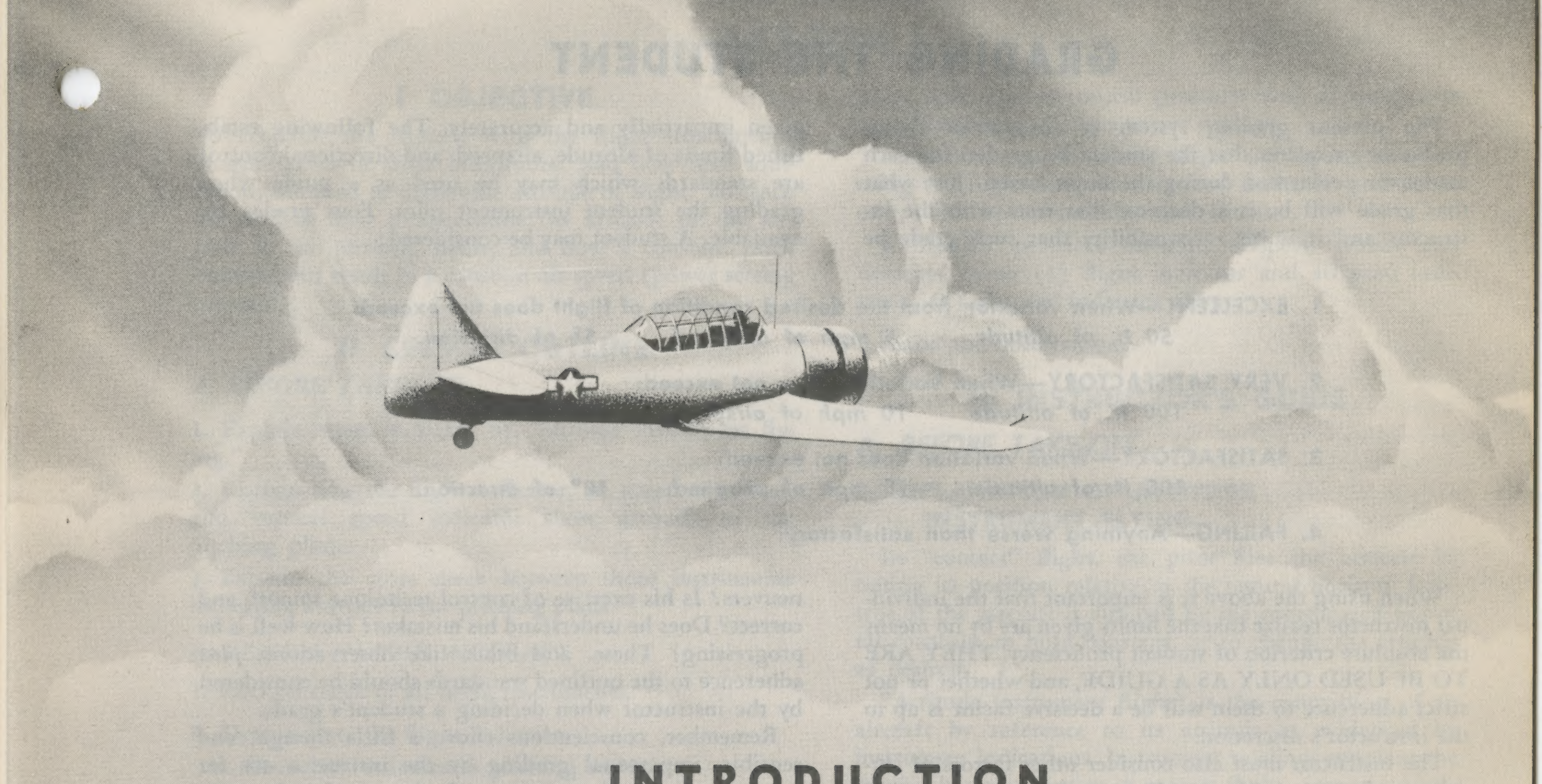




INTRODUCTION

A high degree of basic instrument flying skill is of the utmost importance in modern-day instrument flight. A pilot not possessed of such skill is unable to fly safely through severe weather conditions, or avail himself of the advantages and improvements in radio facilities. The AAF Instrument Approach System, Radio Direction Finding procedures, and even a normal radio range letdown cannot be safely accomplished by a pilot who must devote all his attention to flying the aircraft. Before any instruction in the advanced phase of instrument flying can be attempted, proficiency in the principles and actual practice of basic instrument flight *must* be attained. This is the responsibility of the basic instrument flying instructor. Proper and adequate instruction of a student in this phase will do much to insure not only his life and safety, but all those who may fly with him.

This syllabus on instrument flying by the "attitude system" is prepared specifically for basic instrument flying instructors. The lessons are covered in detail and are arranged to teach instrument flight by the same method as the student is first taught to fly in primary training school. This similarity of instruction procedures takes fullest advantage of the student's previous knowledge and experience. Time is not spent teaching new principles of flight; the student is taught to apply what he already knows to new flying conditions, namely, flying by instruments.

In primary flying school, the student is first taught how to control the pitch attitude of the aircraft, the nose attitude which is required for level flight, and how changes in this attitude result in climb or descent.

Next, the student is taught to bank and turn. The position of struts, wing insignia, etc., on the horizon are discussed in teaching the proper degree of bank. At the same time the student is required to use proper pitch attitude for maintenance of level flight during turns.

Finally, the third basic control is covered, namely, power settings, and their relation to the speed and attitude of flight.

The same method is used in teaching the "attitude system" of instrument flight. The student first learns to control the aircraft on those instruments which indicate the pitch attitude; second, on those which indicate bank attitude; and finally—just as in primary training—power is introduced.

For the purpose of standardization, instrument instructors will teach the course lesson by lesson; each will be thoroughly learned and understood by the student before advancing to the next. Although it is imperative to follow the lesson sequence as outlined, this syllabus is not intended to infringe on the instructor's initiative. Special approaches and tricks of the trade should be a part of the teaching technique and should be used to fullest advantage at all times, provided the sequence and procedures outlined for each lesson are followed.

The material for each lesson is divided into three parts: (1) a brief note on the purpose of the particular lesson; (2) an outline of the lesson; and (3) a guide to the instructor, covering in detail each point of instruction.

GRADING THE STUDENT

The present grading system of instrument flying proficiency requires that the student be graded for each maneuver performed during the day's lesson. Just what that grade will be is a decision that rests with the instructor and it is his responsibility that such grade be given impartially and accurately. The following established limits of altitude, airspeed, and directional control are standards which may be used as a guide when grading the student instrument pilot. Four grades are available. A student may be considered:

1. **EXCELLENT—When variation from the desired condition of flight does not exceed:**
   50 ft. of altitude   5 mph of airspeed   5° of direction.
2. **VERY SATISFACTORY—When variation does not exceed:**
   100 ft. of altitude   10 mph of airspeed   5° of direction.
3. **SATISFACTORY—When variation does not exceed:**
   100 ft. of altitude   10 mph of airspeed   10° of direction.
4. **FAILING—Anything worse than satisfactory.**

When using the above it is important that the individual instructor realize that the limits given are by no means the absolute criterion of student proficiency. THEY ARE TO BE USED ONLY AS A GUIDE, and whether or not strict adherence to them will be a decisive factor is up to the instructor's discretion.

The instructor must also consider other factors of student performance. How well does the student control pitch, bank, and power when executing the various maneuvers? Is his exercise of control technique smooth and correct? Does he understand his mistakes? How well is he progressing? These, and other like observations, *plus* adherence to the outlined standards should be considered by the instructor when deciding a student's grade.

Remember, conscientious effort, a little thought and sensible, impersonal grading by the instructor are far more important than any standards or rules that this technical order could direct.

INSTRUMENT COCKPIT CHECK

Before giving any instructions in the air, make sure the student receives adequate cockpit instructions. Special attention should be given to that part of the cockpit check devoted to the instruments. Prior to every take-off throughout the course, the student will repeat over the interphone the established cockpit check for the type aircraft flown. The instrument part of the check will be given in the following sequence:

1. **SUCTION GAGE** ***should indicate between 3.75 and 4.25 inches Hg. during engine run-up.***
2. **AIR SPEED.—*Pitot head cover must be removed. Reading should be zero.***
3. **DIRECTIONAL GYRO** ***should be set to the compass heading and uncaged. Check reaction with taxiing turns.***
4. **FLIGHT INDICATOR** ***should be uncaged and miniature aircraft properly adjusted. Horizon bar should precess to three-point position.***
5. **ALTIMETER** ***should be adjusted to "altimeter setting" obtained from tower, and this reading checked with field elevation.***
6. **TURN AND BANK.—*While stationary, the ball should be in the center. When taxiing, check needle for proper deflection and see that the ball moves freely in the race.***
7. **RATE OF CLIMB.—*Needle should indicate "0."***
8. **COMPASS** ***headings should correspond with published bearings of runways, and should move freely while taxiing. Compass bowl should be full of liquid.***
9. **CARBURETOR HEAT.—*Full heat should be applied momentarily, and the carburetor heat gage should indicate adequate heat is available.***
10. **ENGINE INSTRUMENTS.**

(For additional information refer to Technical Order No. 30-100A-1).

LESSON I

I OBJECTIVE

To acquaint the student with the flight instruments, interpretation of their indications, and how such indications are used to determine attitude of flight. To teach the student how to determine the attitude of the aircraft in the pitching plane, and how a constant pitch attitude will result in a constant air speed (power setting constant).

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Explain what is meant by "attitude instrument flying."

2. Explain how the flight indicator, air speed, altimeter, and vertical speed indicator show attitude in the pitching plane.

3. Explain the cross check between those instruments indicating attitude in the pitching plane.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Demonstrate the flight indicator.

a. Show how it indicates pitching attitude.

b. Show its limits in pitching plane.

c. Show its uncaging error in pitching plane.

d. Have student practice pitch control with flight indicator (level and return to level).

3. Demonstrate the airspeed indicator.

a. Show how the air speed is used to control pitch attitude.

b. Airspeed constant, attitude constant.

c. Show how slow changes of air speed indicate small changes of attitude, and how rapid changes in air speed indicate extreme changes.

d. Have the student practice pitch control, using the flight indicator and airspeed indicator.

4. Demonstrate the altimeter.

a. Show how changes of altitude indicate changes of attitude in the pitching plane. Constant altitude indicates constant attitude.

b. Show apparent lag when indicating changes in pitch attitude.

c. Have the student practice pitch control, cross checking attitude changes with (1) flight indicator, air speed, and altimeter; (2) airspeed indicator and altimeter.

5. Demonstrate the vertical speed indicator.

a. Show presence of lag when extreme changes of attitude are made.

b. Show how it may be used to show deviation from constant attitude.

6. Student practices control of flight in the pitching plane and relieves control pressures with elevator trim as the instructor changes power settings.

a. Student practices level flight and return to level, using (1) flight indicator, airspeed indicator, and altimeter; (2) airspeed indicator and altimeter.

b. Student practices constant airspeed climbs and descents, using (1) flight indicator and airspeed indicator; (2) airspeed indicator alone.

7. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. EXPLANATION OF ATTITUDE INSTRUMENT FLYING.

In "contact" flight, the pilot flies the aircraft by noting its position relative to the natural horizon. Control of the aircraft is attained by the coordinated use of all controls, to hold constant, or to change the attitude as desired.

"Attitude instrument flight" is the controlling of an aircraft by reference to its attitude as evidenced by instrument indications. Instrument readings supplant the natural horizon. Just as in contact flight, proper attitude is attained by coordinated use of all controls.

Point out to the student that, regardless of the maneuver, only three factors of control interest him: (1) correct pitching attitude, (2) correct banking attitude, and (3) correct power setting. By controlling these things correctly, the maneuver will be executed properly.

2. EXPLANATION OF FLIGHT INDICATOR, AIRSPEED, ALTIMETER, AND VERTICAL SPEED INDICATOR.

a. THE FLIGHT INDICATOR (artificial horizon) gives a direct reading of the pitch attitude of the aircraft. Remind student of contact procedure and how proper attitude was attained in climbs, glides, or level flight, by raising or lowering the nose of the aircraft in relation to the horizon. The student should realize that exactly the same procedure is to be followed in instrument flight, by raising or lowering the miniature aircraft on the artificial horizon. Stress the necessity for *small* changes because of the size relationship of indications of the natural and artificial horizons.

b. THE AIRSPEED INDICATOR is an indirect reading of the pitch attitude of the aircraft. For any given power setting, the air speed will determine the correct pitch attitude for level flight, climbs, or descents. If the air speed is too high for a given power setting, the nose of the aircraft is too low, or vice versa.

c. THE ALTIMETER gives an indirect reading of the pitch attitude of an aircraft in level flight. When a pilot desires to maintain level flight, he can cross-check the attitude indications, as shown on the flight indicator, with those of the sensitive altimeter. Immediately after the sensitive altimeter starts up or down, the corresponding small changes in attitude (reflected by the miniature aircraft with relation to the horizon bar) are made to correct the altimeter movements.

When the student is controlling pitch attitude by reference to the altimeter, caution him to make allowance for the time required by the aircraft to assume level flight attitude after control pressure has been applied. By watching the trend of the altimeter movements, the student can tell very closely when the correct attitude has been assumed. In an extremely violent up- or downdraft in rough air, this will not hold true, and the pilot must revert back to his flight indicator and airspeed indicator in order to maintain a safe air speed and proper attitude.

d. THE VERTICAL SPEED INDICATOR can be used to show deviation from constant attitude in straight and level flight. When using this instrument, always remember that it indicates the rate of *change of altitude* and not the *actual attitude* of the aircraft. The instrument is difficult to use in controlling the attitude of the aircraft because of the high rate of vertical accelerations of modern high-speed aircraft, and its unreliable readings in rough air.

When the air speed is constant, however, it may be used to check rates of climb and descent. Therefore, the indications of the vertical speed are determined by the power setting, and not by changing the pitch attitude of the aircraft. In straight and level flight, the vertical speed indicator can be used to show deviation from level flight and must be controlled by small corrections in the pitch attitude of the aircraft. At all times the student should keep in mind the amount of lag in the instrument and allow the instrument sufficient time to "settle down" before making additional pitch corrections.

3. CROSS CHECK BETWEEN THOSE INSTRUMENTS SHOWING ATTITUDE IN PITCHING PLANE.

Impress upon the student that the flight indicator is not the only instrument indicating pitch attitude. This instrument will be demonstrated first, as it is the easiest and most realistic instrument with which to introduce instrument flying. Stress that the most valuable function of the flight indicator is to give the pilot a quick and correct indication of any change in attitude, and increase the ease and accuracy of instrument flight. Stress that it must be used in conjunction with other instruments indicating the pitch attitude of the aircraft.

B. LESSON IN THE AIRCRAFT

1. COCKPIT CHECK.

2. DEMONSTRATION OF FLIGHT INDICATOR.

a. To demonstrate the similarity between the horizon bar and actual horizon, place the nose of the aircraft above and then below the natural horizon. Have the student note that he receives the same indication on the flight indicator as he does by watching real horizon and aircraft.

b. Pull nose of aircraft up until the flight indicator "spills." Bring to student's attention the loss of proper indication when the limits of the instrument are exceeded.

c. To stress the necessity of being in level flight when uncaging, place the aircraft in a climbing attitude and have student cage, then uncage the flight indicator. Return to level flight and have student observe the false reading of the instrument.

d. Allow the student to take control and practice control of pitch attitude by use of the flight indicator. Occasionally place the aircraft in a steep climb or descent and have the student return to level flight.

3. DEMONSTRATION OF AIRSPEED INDICATOR.

a. Fly the aircraft straight and level by using a constant power setting. Point out to the student that the air speed remains constant. Holding a constant pitch attitude, repeat the same in a climb or descent, again having the student observe the resultant constant air speed. Make small changes in pitch attitude and have student notice slow changes in air speed. Make extreme changes in pitch attitude of aircraft and point out fast changes in air speed. Then, having assumed normal air speed in level flight, have student use the elevators to climb or dive the aircraft. Explain that the air speed will not reflect *immediately* the change of attitude as does the artificial horizon, but the approximate attitude must be obtained and then time allowed for the aircraft to *accelerate* or *decelerate.* This acceleration or deceleration is immediately reflected in the airspeed indicator, *as there is no appreciable lag in this instrument.*

b. Explain that when the elevators are used to obtain and *control* the air speed, only a *slight* movement is usually necessary to bring about the desired result.

c. Using a constant power setting, have the student hold a constant air speed in level flight, then in climbs and descents. Have him use the flight indicator to make small corrections in attitude and wait for the air speed to settle down to a constant reading before making any additional corrections.

4. DEMONSTRATION OF THE ALTIMETER.

a. Using a constant power setting, fly the aircraft straight and level; point out to student that to maintain constant altitude, the pitch attitude must also remain constant. Pull the aircraft up until indications of a climb are noticeable on the altimeter and point out the change in pitch attitude.

b. If altitude is being gained, the nose is too high and should be lowered. If altitude is being lost, the nose is too low and should be raised. The student should further understand that when changing attitude with reference to the altimeter, allowance must be made for the time required for the aircraft to assume the desired attitude after control pressure has been applied. By watching the trend of the altimeter movements, the pilot can determine fairly well whether correct attitude has been assumed.

c. Student practices level flight after he understands the use of the altimeter, using (1) flight indicator, airspeed indicator, and altimeter; (2) airspeed indicator and altimeter.

5. DEMONSTRATION OF THE VERTICAL SPEED INDICATOR.

a. Place the aircraft in level flight. Have student watch the vertical speed indicator as the airplane is alternately put into steep climbing and diving attitudes. Call his attention to the excessive lag in the instrument's indications. Even though the aircraft may be in a diving attitude during these rapid changes of attitude, the vertical speed indicator will momentarily indicate level, or even a climb, until the lag fades out. To demonstrate how the instrument will show deviation from original attitude, maintain level flight until the indicator reads zero; then place the aircraft in a climbing attitude and point out how it shows deviation from original attitude.

b. Explain clearly the above indications to the student, even though he will not be required to control the attitude of the aircraft by this instrument until later.

6. STUDENT PRACTICES CONTROL OF FLIGHT IN THE PITCHING PLANE.

a. Student practices pitch control by use of flight indicator and airspeed indicator. Have student use elevator trim to take pressure off the stick as the instructor changes power settings, so that the airplane will fly at approximately the desired pitch attitude with "hands off" the controls.

b. Student practices level flight and return to level, using (1) flight indicator, airspeed indicator, and altimeter; (2) airspeed indicator and altimeter.

c. Student practices constant air speed, climbs, and descents, using (1) flight indicator and airspeed indicator; (2) airspeed indicator alone.

d. Go immediately to another combination as soon as the student is proficient on one combination of instruments. Do not waste time. Remember the success of the student in this course depends upon his becoming proficient on each lesson, and on *each* combination of instruments before advancing to another phase.

7. LAND AND HOLD CRITIQUE.

LESSON II

I OBJECTIVE

To teach the student to determine attitude of the aircraft in the banking plane. To combine bank control with pitch control to produce straight and level flight.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Review previous lesson.

2. Explan how the flight indicator, directional gyro, and turn needle show attitude in the banking plane.

3. Explain cross check between those instruments showing attitude in the banking plane.

4. Explain relationship of the rudder trim to the ball.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Student climbs at constant air speed to working area.

3. Review the material in the previous lesson as needed.

4. Demonstrate the flight indicator.

a. Show the relation of the wing and horizon of the flight indicator to actual wings and horizon.

b. Banking scale.

c. Limits of the instrument in banking plane.

d. Uncaging errors in the banking plane.

e. Have student practice bank control with flight indicator.

5. Demonstrate the turn needle.

a. Show how the needle indicates rate of turn and indirectly the degree of bank.

b. Perform a "single-needle-width" turn while changing air speed from 80 to 150 mph to show accompanying change in degrees of bank on the flight indicator.

c. Show that the needle when centered will indicate straight flight.

d. Have the student practice bank control with the turn needle.

6. Demonstrate directional gyro.

a. Turning means banking; thus bank will be directly indicated on the directional gyro.

b. Show that the directional gyro gives exact headings and has no turn errors.

c. Show the relation of the directional gyro to the magnetic compass.

d. Show limits of directional gyro.

e. Have the student practice control in the banking plane on the following instruments (first without, then with hood closed): (1) flight indicator, directional gyro, and turn needle; (2) flight indicator and directional gyro; (3) directional gyro and turn needle; (4) turn needle alone.

7. Demonstrate ball (slip-skid) indicator.

a. Show how the ball will indicate slip or skid caused by incorrect rudder trim.

b. Show how to trim ball to center.

8. Have the student practice straight and level flight while maintaining constant air speed and power on the following combinations of instruments: (1) flight indicator, directional gyro, airspeed indicator altimeter; (2) directional gyro, turn needle, airspeed indicator, and altimeter; (3) flight indicator, turn needle, airspeed indicator, and altimeter; (4) turn needle, airspeed indicator, and altimeter.

9. Constant airspeed descent to field area.

10. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. REVIEW PREVIOUS LESSON.

2. EXPLANATION OF FLIGHT INSTRUMENTS RELATING TO BANKING PLANE.

a. Remind the student that in contact flight he controlled banking attitude of aircraft by watching the position of the wings of the aircraft in relation to the actual horizon. Now he has only to substitute the miniature aircraft and horizon bar of the flight indicator for the real aircraft and the horizon, and bank will be indicated accurately.

b. Explain that any time the wings of the aircraft deviate from the level position, the aircraft will begin to turn. Therefore, the banking attitude of the aircraft is indirectly indicated on the directional gyro.

c. Explain that the turn needle is also a "bank indicator," and that any sustained position of the needle to one side of the center indicates that a turn, therefore a bank, is being made in that direction.

3. EXPLANATION OF INSTRUMENT CROSS CHECK.

Make clear to student that if he has more than one instrument available showing the attitude in the banking plane, a continual check of one against the other is necessary to determine if both are operating, and to correct any errors that may be in one of the instruments.

4. RELATIONSHIP OF RUDDER TRIM TO THE BALL.

Explain that the ball indicates if the aircraft is in a slip or skid, or if flight is coordinated. If the ball is displaced to one side of the center, it indicates that rudder pressure is needed on the side to which it is displaced. If such condition exists, the pilot simply needs to apply rudder trim to the side that ball is displaced until ball returns to center.

B. *LESSON IN THE AIRCRAFT*

1. COCKPIT CHECK.

2. CONSTANT AIRSPEED CLIMB.

After take-off, student takes control of aircraft and holds constant airspeed climb to working area. Make sure that the student makes proper use of elevator trim.

3. REVIEW PREVIOUS LESSON.

4. DEMONSTRATION OF FLIGHT INDICATOR.

a. Take control of the aircraft and have the student watch the flight indicator as the aircraft is rolled from one bank to the other; point out similarity between movements of the miniature aircraft and the real aircraft. Convince the student that when he is under the hood, proper control of the miniature aircraft will insure proper control of the actual aircraft. This is true because the horizon bar is parallel to the actual horizon, and any attitude of the real aircraft will be indicated quickly and accurately by the flight indicator. To aid his understanding of this principle, have the student imagine himself in the miniature aircraft; i.e., place himself in the white dot in the center. Or he can consider the miniature aircraft as flying ahead of him in formation, in which case he can readily visualize it as climbing, diving, and banking to the right or left. Point out the banking scale at the top of the instrument, and how the pointer indicates the degree of bank.

b. Take control of the aircraft and demonstrate the limits of the flight indicator in the banking plane by exceeding the limits. Point out how the horizon "spills."

c. Place the aircraft in a bank and have the student cage and uncage the flight indicator. Return wings to level and point out that the instrument indicates bank.

d. Stress the importance of uncaging instruments while in straight and level flight. Now have student cage, and then partially uncage (about ⅓) the instrument. Place the aircraft in a bank and point out that instrument topples with only a shallow bank. Stress importance of fully uncaging the instrument.

e. Student will go under hood for the first time and practice holding wings level with the flight indicator, holding constant attitude as taught in previous lesson.

5. DEMONSTRATION OF TURN NEEDLE.

a. Demonstrate by rolling from one bank to another how the needle will show attitude in the banking plane. At the same time point out that when the aircraft is banked, it is also turning. The turn is indicated on the turn needle; therefore, an indirect indication of the banking attitude is received.

b. Demonstrate a single-needle-width turn with air speed varying from 80 to 160 mph, pointing out that the higher the air speed, the greater the degree of bank necessary for the same indication on turn needle.

c. Demonstrate that the needle when centered (and with proper trim), indicates straight flight with wings level.

d. Have student go under the hood and practice holding wings level by using the turn needle. Instructor will occasionally place the airplane in bank and have student return it to level position.

6. DEMONSTRATION OF DIRECTIONAL GYRO.

a. As was just demonstrated on the turn needle, turning means banking; therefore the directional gyro, just as the turn needle, gives an indirect indication of bank.

b. Point out that the directional gyro always gives exact headings and has no turn error.

c. Explain that, having no direction-seeking qualities, the directional gyro must necessarily be adjusted to magnetic headings.

d. Exceed limits of the instrument and have the student note the resultant indications.

e. Now have the student go under the hood and practice flying with the wings level and holding a constant altitude, using the following combinations of instruments (first with the hood open and then with hood closed): (1) flight indicator, directional gyro, and turn needle; (2) flight indicator and directional gyro; (3) directional gyro and turn needle; (4) turn needle alone.

7. DEMONSTRATION OF BALL (SLIP-SKID) INDICATOR.

The ball is used to determine if the airplane is slipping or skidding. Consequently, the ball will determine whether or not correct rudder trim is being used. While in straight and level flight, adjust the rudder trim until the ball is off-center. Then show the student how it is to be trimmed to center. Demonstrate the same things in climbs and descents. Impress upon the student that the ball must be trimmed to center at all times.

8. PRACTICE OF STRAIGHT AND LEVEL FLIGHT.

a. Have student go under hood and practice straight and level flight on the following combinations of instruments: (Instructor will occasionally put the airplane in a bank and have student return to straight and level flight): (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) directional gyro, turn needle, airspeed indicator, and altimeter; (3) flight indicator, turn needle, airspeed indicator, and altimeter; (4) turn needle, airspeed indicator, and altimeter.

b. Explain that if correct pitch attitude and correct bank attitude are controlled properly, straight and level flight will result. (It is assumed that the airplane is properly trimmed.)

c. Point out the importance of cross checking the instruments. Remind the student that the flight indicator is not the only instrument that will indicate bank attitude, and must be used with other instruments that show the banking attitude of the aircraft.

9. CONSTANT AIRSPEED DESCENT.

Student practices constant airspeed descent to field area.

10. LAND AND HOLD CRITIQUE.

LESSON III

I OBJECTIVE

To introduce power control and the use of trim control with power changes. To teach the student climbs and descents.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Explain the use of power and its effect on attitude and trim.

2. Explain proper method of entering and leveling off from constant airspeed climbs and descents.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Student practices constant airspeed climbs to working area.

3. Review previous lessons as needed to perfect pitch and bank control.

4. Demonstrate elevator and rudder trim.

a. Show that elevator trim is needed when power changes are made in straight and level flight.

b. Show that rudder trim is needed when power is changed in straight and level flight (as indicated by ball).

c. Student practices trim control in straight and level flight. (Instructor changes power from high to low settings.)

5. Demonstrate power changes.

a. Demonstrate power control in changes of air speed in straight and level flight.

b. Student practices changing of power and air speed in straight and level flight, using (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) flight indicator, turn needle, airspeed indicator, and altimeter; (3) turn needle, airspeed indicator, and altimeter.

6. Demonstrate climbs and descents.

a. Power and pitch control in entering and leveling off from straight climbs.

b. Power and pitch control in entering and leveling off from constant airspeed descents.

c. Student practices climbs and descents, using the following combinations of instruments: (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) flight indicator, turn needle, airspeed indicator, and altimeter; (3) turn needle, airspeed indicator, and altimeter.

7. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. EXPLANATION OF POWER IN RELATION TO ATTITUDE AND TRIM.

a. Student should thoroughly understand the relationship of power to attitude and how at any normal air speed, the power will determine whether flight will be level, climbing or descending. For example, cruising air speed if maintained with cruising power will result in level flight. If the power is increased, a climb will result. Decrease the power and a descent will result.

b. Point out to student the various power settings required for different conditions of flight (cruise, climb, descent, etc.). Explain that as power is increased or decreased, compensation must be made in the trim of the aircraft. Elevator trim will be needed as the nose tends to either lower or raise with the power change. Rudder trim must be used to overcome the effect of torque. With a constant power setting, if the nose of the aircraft is lowered and air speed is allowed to build up, the nose will yaw to the right. If the nose of the aircraft is pulled up and air speed falls off, then the nose will yaw to the left. If the air speed is held constant and power reduced, the nose will yaw to the right. If power is increased, then the nose will yaw to the left. (See T. O. No. 30-100A-1, Section II, Aerodynamics.)

2. METHOD OF ENTERING AND LEVELING OFF FROM CLIMBS AND DESCENTS.

a. Explain that to enter or level off from a climb or descent, only two components of control, pitch attitude and power setting, must be changed. If the aircraft is flying straight and level, the pilot simply applies climbing power to enter a climb, and at the same time raises the nose to approximate climbing position. As the air speed falls off, small corrections of attitude will usually be necessary to obtain the desired airspeed reading. At the same time both elevator and rudder trim must be corrected to the new power and air speed.

b. To level off from a climb, the pilot must change the same two components of control, pitch attitude and power, that he did to enter the climb. Shortly before the desired altitude is attained, lower the nose to stop and hold the altimeter at the desired reading. Do not reduce the power to cruising value until the air speed approaches the desired figure. Then, adjust trim for new air speed and power setting.

c. To enter a descent, power is reduced to the proper setting for the descent desired. To avoid undesirable loss of altitude, gradually raise the nose of the aircraft to maintain a constant altitude, until the air speed approaches the desired reading for descent; then, ignoring altitude, make adjustments in pitch to keep air speed at the desired reading. Adjust trim for new air speed and power setting.

d. Tell the student that there are two methods of leveling off from a descent. The first is to level off and maintain descending air speed. The other is to level off at cruising speed.

(1) In the first method, air speed and power are to be held constant until about fifty feet above the desired altitude. Then increase power to a setting that will maintain descending air speed in level flight. At the same time, slightly raise the nose to hold air speed constant, and trim aircraft for the new attitude and power setting.

(2) In the second method, when about 100 feet above the desired altitude, change power to cruising power setting and continue to hold descending attitude. As the aircraft approaches the desired altitude, raise the nose to level flight attitude and trim for cruising power and air speed.

B. *LESSON IN THE AIRCRAFT*

1. COCKPIT CHECK.

2. CONSTANT AIRSPEED CLIMB.

Constant airspeed climb to working area, using combination of instruments on which student displays the greatest weakness.

3. REVIEW PREVIOUS LESSON.

4. DEMONSTRATION OF ELEVATOR AND RUDDER TRIM.

a. Demonstrate that if power is applied in level flight, the airplane will have a tendency to go into a nose-high attitude. Forward pressure on the stick is necessary to keep the aircraft in a level attitude. This pressure is relieved with elevator trim. If power is decreased, the nose will have a tendency to drop. Back pressure must be applied to the stick to hold level attitude, and, again, pressure is relieved with elevator trim.

b. Demonstrate the effect of torque with a change of air speed or throttle setting. First, with throttle setting constant, lower the nose and increase speed; have the student notice the resultant yaw to the right. Decrease speed and point out that the nose yaws to the left. Now hold the airspeed constant and decrease power. Call student's attention to the fact that this has the same effect as increasing air speed; i.e., the nose will yaw to the right. Then open the throttle and have him note the almost immediate yaw to the left.

Emphasize that when increasing speed or when reducing the power, left rudder trim is needed. When the speed is reduced and the power setting remains constant, or if power is added, right rudder trim is needed. In each case, the need for trim will be indicated by the ball, which will be off center.

c. Student practices trim control in straight and level flight. (Instructor changes power from high to low power settings.)

5. DEMONSTRATION OF POWER CHANGES.

a. Demonstrate that pitch and power are the only variable components of control necessary to fly level at differing air speeds. A change of power will result in a new air speed which will require a change of pitch attitude. Point out that at low air speeds a nose-high pitch attitude is necessary to maintain constant altitude. The reverse is true when the airspeed is high. In each case, trim must be reset for the new condition of flight.

b. Student practices changing of power and air speed in straight and level flight, using: (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) flight indicator, turn needle, airspeed indicator, and altimeter; (3) turn needle, airspeed indicator, and altimeter.

6. DEMONSTRATION OF CLIMBS AND DESCENTS.

a. Demonstrate power and pitch control in entering and leveling off from climbs and descents. For a detailed explanation of proper procedure to be used in these maneuvers, refer to the explanation given before take-off.

b. Make sure that the student has a thorough understanding of each maneuver before attempting to execute it. He must, upon entry into the maneuver, understand the components of control that will remain constant and the ones that are variable for that specific maneuver. For example, in entering a climb from level flight, student must vary pitch attitude and power while bank attitude remains constant.

c. Student practices climbs and descents, using: (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) flight indicator, turn needle, and airspeed indicator; (3) turn needle, airspeed indicator, and altimeter.

7. LAND AND HOLD CRITIQUE.

LESSON IV

I OBJECTIVE

To teach turns, medium banked turns to headings, and turns in climbs and descents.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Explain turns — coordinated entry and recovery, aileron drag, and effect of slip and skid.

2. Explain timed turns.

3. Explain turns to predetermined headings.

4. Explain instrument take-off.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Demonstrate instrument take-off with student observing instruments.

3. Review previous lesson as needed.

4. Demonstrate turns.

a. Turn by rudder alone; show how this results in skid and how resultant skid is indicated by ball.

b. Turn by aileron alone; show how this results in slip and how slip is indicated by ball.

c. Aileron drag. Show (1) how it is indicated by directional gyro and turn needle; (2) how indicated by nose of aircraft swinging on horizon; (3) how to avoid it by coordinated use of controls.

d. Student practices coordinated turns, using from 15° to 30° of bank, first using flight indicator and then turn needle.

5. Demonstrate turns to predetermined headings on directional gyro.

a. Instructor shows method of rolling out on predetermined heading.

b. Student practices turns to predetermined headings, using various degrees of bank and (1) flight indicator, directional gyro, airspeed indicator, and altimeter; and (2) directional gyro, turn needle, airspeed indicator, and altimeter.

6. Demonstrate timed turns.

a. Show how needle is calibrated to give 3° per second turn for a standard rate turn.

b. Show how turn can be timed by maintaining proper degree of bank on flight indicator.

c. Show how turn needle may be checked against degree of bank (as shown on flight indicator) to determine accurate calibration.

d. Student practices timed turns to headings, using (1) flight indicator, directional gyro, turn needle, airspeed indicator, altimeter, and clock; and (2) turn needle, airspeed indicator, altimeter, and clock.

7. Demonstrate turns in climbs and descents.

Student practices turns of all types, using:

a. Flight indicator, directional gyro, airspeed indicator, and altimeter.

b. Turn needle, airspeed indicator, altimeter, and clock.

c. Directional gyro, turn needle, airspeed indicator, and altimeter.

8. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. EXPLANATION OF TURNS.

a. Instruct the student that to turn an aircraft, he simply has to enter a bank in the direction he wishes to turn, and that the steeper the bank, the faster the rate of turn.

b. A small part of the vertical lift of the wings is used to turn the aircraft as it enters a turn. Unless some compensation is made for this loss of vertical lift, the airplane will not maintain level flight and will lose altitude. To prevent this, the angle of attack must be increased by slightly raising the nose. Tell the student that because the nose must be raised slightly to maintain altitude, two components of control, namely *pitch attitude* and *bank attitude,* are variable in a level turn. He must hold the bank attitude that will give him the desired rate of turn, and he must hold a pitch attitude that will produce level flight. Explain that the greater the air speed, the greater the degree of bank required for a given rate of turn; and as the bank increases, the greater is the pitch attitude correction necessary to hold a constant altitude.

c. Caution the student that the same coordinated use of controls must be used in making a turn on instruments as is used in contact flight. Explain the effect of aileron drag upon entry and recovery from a turn, and that this necessitates the use of rudder in conjunction with aileron control to enter and recover properly from any turn.

d. Point out that if excessive rudder is used, a skid results, and the ball will go to the high side of the turn. If insufficient rudder pressure is used, a slip will result, and the ball will go to the low side of the turn. Such slip or skid will impair the aerodynamic efficiency of the aircraft and alter the rate of turn for a given degree of bank. A skid will increase the rate of turn for a given angle of bank whereas a slip will decrease the rate of turn for the same angle of bank. In a skid the airplane is being turned by the bank of the wings and by the propeller thrust acting inward due to rudder action. Consequently, the aircraft is turning faster than it would if acted upon by the lift of the wings alone. In a slip, the rudder prevents the aircraft from turning at the rate it should for the angle of bank used.

e. Instruct the student to use the rudder to bring the ball bank indicator to the center when making corrections for a slip or skid. (The ball bank indicator is the only instrument which shows skidding or slipping.) Inside rudder is used to correct for a slip, and outside (or less inside) rudder is used to correct for a skid. Any correction for such slip or skid will vary the rate of turn. Be sure that the student realizes this fact so that when correcting for a slip or skid, he will be prepared to vary the angle of bank to keep the rate of turn constant.

2. EXPLANATION OF TIMED TURNS.

a. Explain that (assuming the turn needle is calibrated properly) when the needle is deflected one-needle-width to either side, the aircraft will turn in the direction of the deflection at the rate of 3° per second. By using this calibration, the student can turn to any desired heading by maintaining a "one-needle-width" turn one second for each three degrees of turn necessary to reach the desired heading. Timing must begin the instant control pressure is applied to enter the turn, and end the instant control pressure is applied to recover from turn.

b. Instruct the student that timed turns to headings may also be made with the flight indicator. To accomplish this, the required degree of bank for a 3° per second turn must be computed by the *true* air speed, and from this point the procedure is the same as in the above turn by needle alone.

c. Tell the student at this time that since a large per cent of the turn needles are slightly out of calibration, the calibration of the instrument can be checked by holding the necessary degree of bank on his flight indicator for a standard rate turn and noting the indication of the needle. If the needle is not deflected exactly one needle width, this must be taken into consideration when making timed turns with the turn needle.

3. EXPLANATION OF TURNS TO PREDETERMINED HEADINGS.

Explain that to turn to a predetermined heading on the directional gyro, the pilot must remember that the aircraft does not stop turning the instant the rollout is begun, but will continue to turn until the wings are perfectly level. Therefore, recovery from the turn must be started before reaching the desired heading. The amount of lead in rolling out will depend upon the individual pilot and airplane. A "lead" of one degree of turn for each two degrees of bank maintained is normally used. For example: with 30° of bank, recovery should begin at 15° before reaching the desired heading.

4. EXPLANATION OF INSTRUMENT TAKE-OFF.

a. When making an instrument take-off, it is imperative that the student be prepared to make quick and accurate coverage of the instrument panel. Unless this is done, proficiency in this particular maneuver cannot be expected.

b. After the aircraft has been lined up with the take-off runway, the directional gyro is set with the magnetic compass, and the remainder of the flight instruments checked. At this point remind the student that when setting the directional gyro he must make certain that it is *uncaged* (often students will forget this). Trim tabs should be set for take-off position. The proper use of throttle is important. It should be opened smoothly and at a rate that will eliminate as much of the effects of torque as possible, and must be *completely opened to take-off setting.*

c. As the aircraft gathers momentum, and until it is air borne, the directional gyro is the primary instrument. The original heading must be maintained. This is accomplished by the use of the rudder. Warn the student that rudder movements must be small as possible and made immediately upon observation of any variation in the original heading. The stick is held in neutral position.

d. As the air speed approaches flying speed, attention should be directed to the flight indicator and the directional gyro. A climbing pitch attitude is maintained by proper stick control. Once the aircraft leaves the ground, flight is conducted as in a normal climb. However, the student must be cautioned that as the air speed is still low, it is of the utmost importance that the pitch attitude not be allowed to become too high, or a stall may result. A *constant, normal climbing attitude* will insure against such occurrence.

B. *LESSON IN THE AIRCRAFT*

1. COCKPIT CHECK OF ALL FLIGHT INSTRUMENTS.

2. DEMONSTRATION OF INSTRUMENT TAKE-OFF.

Instructor demonstrates instrument take-off, pointing out indications of various instruments. Emphasize directional control while the aircraft is on the ground, and correct pitch and bank control once the aircraft is airborne.

3. REVIEW PREVIOUS LESSON.

4. DEMONSTRATION OF TURNS.

a. Demonstrate turn by rudder alone and how the resultant skid is indicated on the ball (slip-skid) indicator.

b. Demonstrate turn by aileron alone and how the resultant *slip* is indicated on the ball (slip-skid) indicator.

c. Demonstrate aileron drag by reducing air speed and then entering a turn by use of aileron alone. Have student observe the momentary yaw of the aircraft in the opposite direction of bank before turning. This is seen by observing the nose of the airplane and the indications of the directional gyro and turn needle. Inform him that because of this phenomena, rudder must be used to enter and recover from all turns. Show, by demonstration, how coordinated use of rudder and stick will prevent such occurrence.

d. Have student practice coordinated turns, using from 15° to 30° of bank. First use flight indicator and then turn needle for bank control.

5. DEMONSTRATION OF TURNS TO PREDETERMINED HEADINGS.

a. Instructor demonstrates several turns to predetermined headings using the directional gyro, and emphasizes the necessity of "lead" in rolling out on the desired heading. Recall to student, and repeat if necessary, the ground discussion on this point. Remind him that the lead is approximately 1° of turn for each 2° of bank maintained.

b. Have student practice turns to predetermined headings, using various degrees of bank and the following combinations of instruments: (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) directional gyro, turn needle, airspeed indicator, and altimeter.

6. DEMONSTRATION OF TIMED TURNS.

a. Demonstrate to the student that any bank which gives him a single-needle-width deflection will result in a turn of 3° per second. A timed turn can also be made by holding the required degree of bank for a standard rate turn on the flight indicator for the *true* air speed at which the aircraft is flying, and timing the turn the same as with the turn needle. Point out that as a slip or skid will alter the rate of turn for a given degree of bank when timing turns by use of flight indicator, the ball must be trimmed to center. (Consult table in Analysis of Maneuvers for degree of bank that will give a standard rate turn at different air speeds.)

b. Demonstrate how to check turn needle against degree of bank to determine if it is calibrated correctly, and if it is not, how to correct for this when making timed turns with the turn needle.

c. Student practices timed turns to given headings, using: (1) flight indicator, directional gyro, turn needle, airspeed indicator, altimeter, and clock; (2) turn needle, airspeed indicator, altimeter, and clock.

7. DEMONSTRATION OF TURNS IN CLIMBS AND DESCENTS.

a. Demonstrate climbing and descending turns by: (1) establishing pitch attitude and power setting for a climb or descent and *then* establishing the banking attitude for the turn, and (2) establishing the climb and turn at the same instant by setting pitch attitude, bank attitude, and power simultaneously.

b. Student practices turns of all types, using: (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) turn needle, airspeed indicator, altimeter, and clock; (3) directional gyro, turn needle, airspeed indicator, and altimeter.

8. LAND AND HOLD CRITIQUE.

LESSON V

I OBJECTIVE

To increase student proficiency in all maneuvers covered thus far.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Discuss all points covered in lessons I through IV.

2. Review instrument take-off.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Student makes instrument take-off with hood open.

3. Student (under hood) climbs to working area, leveling off at 500-foot intervals.

4. Student practices change of air speed in straight and level flight, using combinations of instruments on which he has shown the greatest weakness.

5. Student performs turns to perfect his bank control, using combinations of instruments on which he has shown the greatest weakness.

6. Constant air speed descent to field.

7. Land and hold critique.

III INSTRUCTOR'S GUIDE

This lesson is set aside to give the instructor an opportunity to increase student proficiency on these maneuvers and combinations of instruments on which the student has displayed the greatest weakness. The time spent should not be just a review, but an instructional period in which the instructor has an excellent opportunity to apply a little "extra something" to insure the success of the individual student.

The instructor should be cognizant that the time spent on instrument flying to date is not sufficient to produce a competent instrument pilot. The attainment of proficiency by each student will depend upon two factors; first, the student must understand thoroughly the principles of instrument flight; second, he must attain speed and accuracy of instrument observation, so that he may correctly apply the principles of control. Failure of either will cause unsatisfactory results. The instructor should determine which of the two, or if both, cause difficulty. If instrument coverage is slow, the instructor should accentuate those maneuvers which require the speediest instrument observation. Practice and time should rid the student of this difficulty. Poor comprehension of the principles of instrument flight may be aided by more detailed explanations, and additional demonstrations. Follow as closely as needed the outline as previously set forth.

LESSON VI

I OBJECTIVE

To teach climbs and descents at a definite rate. To teach steep turns.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Review weak points of previous lesson.

2. Explain procedure to be used when making climbs and descents at a definite rate.

3. Explain vertical "S" maneuver.

4. Explain proper method of executing steep turns.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Student makes instrument take-off with hood closed.

3. Demonstrate descents at a given rate.

a. Show proper entry.

b. Show proper method of controlling vertical speed with throttle.

c. Show the necessity of adding power in descending turn to maintain constant rate of descent.

d. Student practices given rate descent. (Stress entry and trim.)

4. Demonstrate climbs at a given rate.

a. Show proper entry.

b. Show proper method of controlling vertical speed with throttle.

c. Show necessity of adding power in climbing turns to maintain constant rate of climb.

d. Student practices constant rate climbs. (Stress entry and trim.)

5. Demonstrate vertical "S" maneuver.

a. Stress proper pitch and power control.

b. Student practices vertical "S," using (1) flight indicator, directional gyro, turn needle, airspeed indicator, and vertical speed indicator; (2) turn needle, airspeed indicator, altimeter, and vertical speed indicator.

6. Demonstrate steep turns.

a. Show proper control technique used in entry, during and recovery from the turn, using: (1) flight indicator, airspeed indicator, and altimeter; (2) turn needle, airspeed indicator, and altimeter.

b. Student practices turns of from 30° to 50° of bank, using: (1) flight indicator, turn needle, airspeed indicator; and altimeter; (2) turn needle, airspeed indicator, and altimeter.

7. Student makes constant rate descent to field.

8. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. REVIEW PREVIOUS LESSON.

2. EXPLANATION OF CLIMBS AND DESCENTS AT A GIVEN RATE.

a. To attain any desired rate of climb or descent, student only has to exercise proper power control; he has already learned to control pitch and bank attitude. The rate of climb or descent, as indicated by the vertical speed indicator, is an exclusive function of the power setting. A decrease of power will increase the rate of descent and decrease the rate of climb while an increase of power will have the opposite effect.

b. Make it clear that airspeed control is essential to proper execution of these maneuvers, and a constant and accurate reading is to be maintained at all times. Variation in the indications of this instrument will greatly increase the difficulty of determining the proper pitch attitude and power control.

c. Explain the approximate power settings required for different rates of climb and descent, and review the procedures that will be used when demonstrating the maneuvers in flight.

3. EXPLANATION OF VERTICAL "S."

This maneuver is designed primarily to give a pilot practice in pitch and power control. It may be used advantageously to utilize time in going to and from the working altitude. Also, it will greatly increase student confidence. Procedure in flying the maneuver is as follows:

a. To effect the gaining of altitude; first, place the aircraft in a normal climb, then, use a power setting that will establish a predetermined rate of climb (the rate will depend upon the type of aircraft being used). After the aircraft has climbed 1000 feet, change the power setting slowly to establish a descent, which is continued until 500 feet of altitude is lost. Again, power should be changed slowly to establish another climb, and the maneuver is repeated. Maintain a constant air speed at all times.

b. If the maneuver is to affect loss of altitude, the descent is 1000 feet and the climb is 500 feet. Emphasize the proper use of controls when changing from a descent to a climb. Caution the student to avoid becoming "sloppy" or inaccurate when the desired altitudes are approached.

c. Pitch and power are the only variable factors throughout this maneuver, as bank attitude will remain constant. Trim control necessarily becomes important because of the constant changing of attitude and power, and must be used at all times if proficiency is desired.

4. EXPLANATION OF STEEP TURNS.

a. A steep turn, for the purpose of instrument training, is one in which more than 30° of bank is used. It is primarily a practice maneuver and is designed only for the purpose of creating student confidence and increasing proficiency of bank, pitch, and power control.

b. Stress that, regardless of the degree of bank, *the same procedure of entry, recovery and control during the turn is used as in normal turns.*

c. Emphasize that the main difficulty is the use of proper pitch control because as the aircraft is banked steeply, a considerable loss of vertical lift results. To compensate for this loss of lift and to insure a constant altitude, it becomes necessary to raise the nose of the aircraft. As the nose is raised, a resultant loss of air speed may be expected. To prevent possible stalling, additional power may be necessary.

B. *LESSON IN THE AIRCRAFT*

1. COCKPIT CHECK.

2. INSTRUMENT TAKE-OFF.

Student makes instrument take-off with hood closed and practices climbing turns to a working altitude.

3. DEMONSTRATION OF DESCENTS AT A GIVEN RATE.

a. Reduce power to the descending value. As the air speed falls off, point out how a loss of altitude is prevented by raising the nose of the aircraft. When the air speed reaches the descent value, lower the nose of the aircraft and maintain constant air speed by small changes of pitch attitude as needed. Only small changes will be necessary to control the descent at the desired rate if the original power setting was accurate.

b. The rate of descent will not show a noticeable change immediately after a change of power because of the lag present in the vertical speed indicator. Remember this so as to prevent "chasing" the instrument's indications with the throttle.

c. Explain that when a descending turn is made, the resultant loss of vertical lift will cause an increase in the rate of descent. To avoid this, a *slight* addition of power during the turn is necessary.

d. Have the student establish descents at a given rate, using different combinations of all flight instruments. Do not allow him to neglect trim.

4. DEMONSTRATION OF CLIMBS AT A GIVEN RATE.

a. Instructor places the aircraft in a climbing attitude and at the same time increases power to the setting required for the desired rate of climb. Make it clear that the initial rate of climb can be ignored until the aircraft has lost momentum and air speed has reached the climbing value. After the climb is established, the rate of climb and air speed will be controlled exactly as in a descent.

b. To enter a climb at a predetermined rate from a descent or slow cruise, simply apply power required for the desired rate of climb. Vary pitch attitude to maintain climbing speed.

c. Recall again the similarity of control factors in a climb and descent. Also stress when executing a climbing or descending turn, a *slight* addition of power is necessary to compensate for the loss of vertical lift brought about by banking, and to insure a constant rate of vertical speed.

d. Student practices definite rate climbs. Emphasize proper technique upon entry and the necessity for resetting trim with each change of power and attitude.

5. DEMONSTRATION OF VERTICAL "S."

a. Use the same procedure in demonstrating this maneuver as explained in the instruction before take-off. Stress use of trim control and point out that only two components of control are variable, pitch attitude and power.

b. Student practices vertical "S," using: (1) flight indicator, directional gyro, turn needle, airspeed indicator, and vertical speed indicator; (2) turn needle, airspeed indicator, altimeter, and vertical speed indicator.

6. DEMONSTRATION OF STEEP TURNS.

a. Instructor enters turn in same manner as when entering a normally banked turn. Point out that as the bank increases, a nose-high attitude must be maintained to avoid loss of altitude. Instruct the student that corrections of pitch attitude will be determined by cross checking the flight indicator with the altimeter.

b. When demonstrating very steep turns, point out the decrease in air speed that occurs during the turn and that power is applied to avoid possible stalling. Little difficulty is expected when executing this type of turn when the flight indicator is available. However, when the flight indicator is not available, a clear picture of pitch attitude is not present. When such a condition exists, the airspeed indicator and altimeter are the best determining factors of pitch attitude, and these instruments must be used extensively when executing steep-bank turns.

c. Depending on the amount of added power and angle of bank, a 5 to 20 mph loss of air speed may be expected. This must be taken into consideration when an interpretation of pitch attitude is made. A nose-low attitude will be indicated by an increase in air speed and a loss of altitude. A nose-high attitude is reflected by a decrease in air speed *plus* an attendant increase in altitude. Accuracy in the accomplishment of this type of turn depends greatly upon the speed of recognition of any change of air speed or altitude. The amount of change in pitch attitude will best be indicated by a *slow rate of change* in air speed, and large changes by a *fast rate of change* in air speed. Actual movement of the airspeed indicator is more readily noticed than the altimeter movement, and close observation of the air speed will often reveal a change in attitude before such change is reflected on the altimeter. Should altitude be gained or lost during the maneuver, any such change in altitude, and the accompanying increase or decrease of air speed, should *first* be stopped *before* any attempt is made to regain the original altitude. This procedure of first *stopping any change prior to correction will greatly reduce the possibility of overcontrolling.*

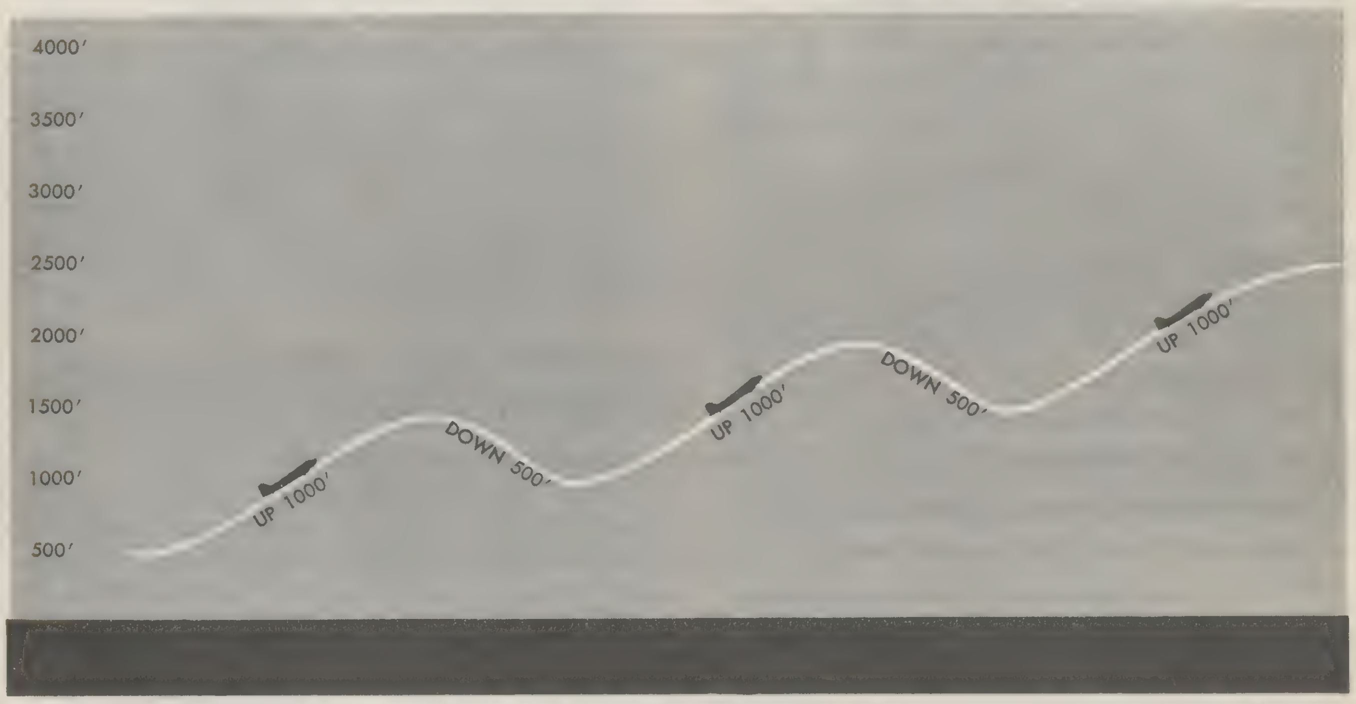
d. Student practices steep turns, using the following combinations of instruments: (1) flight indicator, airspeed indicator, and altimeter; (2) turn needle, airspeed indicator, and altimeter.

e. Student practices turns of from 30° to 50° of bank, using: (1) flight indicator, turn needle, airspeed indicator, and altimeter; (2) turn needle, airspeed indicator, and altimeter.

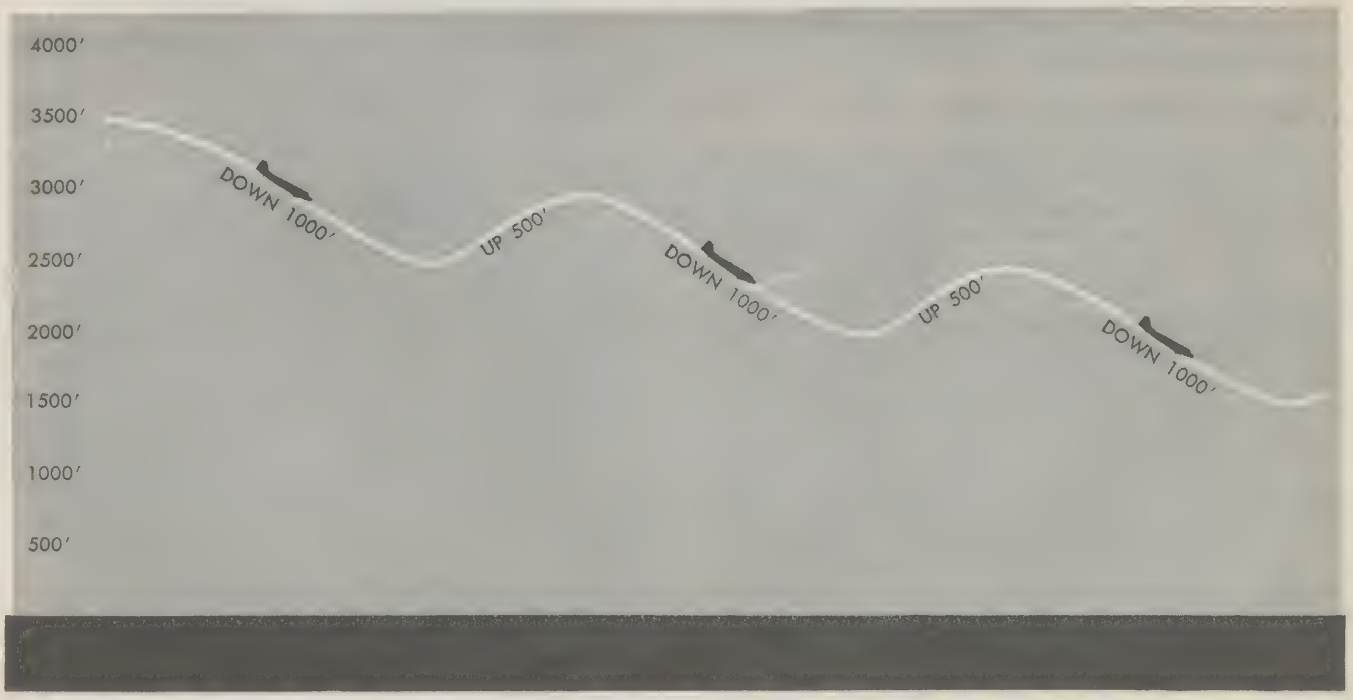
7. CONSTANT RATE DESCENT.

Student makes constant rate descent to field.

8. LAND AND HOLD CRITIQUE.



Ascending Vertical "S"



Descending Vertical "S"

LESSON VII

I OBJECTIVE

To teach proper use of the magnetic compass. To teach pattern "A."

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Discuss weak points of previous lesson.
2. Explain the magnetic compass.
    a. Turning errors on headings of north and south.
    b. Acceleration and deceleration errors on headings of east and west.
    c. Procedures used to compensate for errors.
3. Explain pattern "A."

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.
2. Student makes instrument take-off and flies vertical "S" to working area.
3. Demonstrate northerly turning error.
4. Demonstrate southerly turning error.
5. Demonstrate acceleration and deceleration error.
6. Demonstrate turns on the magnetic compass and turn needle.
7. Demonstrate pattern "A."
8. Constant rate descent to field.
9. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. REVIEW PREVIOUS LESSON.

2. EXPLANATION OF MAGNETIC COMPASS.

a. When the aircraft is banked on certain headings, the compass will not indicate correct magnetic headings. The error will be considerable and will depend upon the degree of bank used when turning. The reason for this should have been explained to the student in ground school. However, unless the errors and the proper method of compensation for them are thoroughly understood by the student, it will be necessary that the instructor give another explanation at this time.

b. The turning errors encountered on headings of north and south, and the absence of same on headings of east and west are to be especially emphasized, as are the errors of acceleration and the deceleration on headings of east and west and the absence of same on north and south.

c. All methods of compensation for these errors depend upon definite and constant degree of bank (between 15° and 18°), which must be maintained if accurate work is to be expected. The student must realize this, and special emphasis is to be placed on this point by the instructor. To best explain the methods and procedures used to compensate for these errors, the instructor should describe in detail each demonstration that will follow take-off, and the expected reaction of the instrument during such demonstration.

3. EXPLANATION OF PATTERN "A."

This pattern has been designed to give the student practice in using the magnetic compass and increases his proficiency in making timed turns. Be sure that he understands the pattern and how it is to be flown, both by timed turns and by making turns on the magnetic compass. Discuss each turn in the pattern separately. Check student's understanding by having him recite the pattern procedure and state his expectation of the reactions of the compass during the various turns.

B. LESSON IN THE AIRCRAFT

1. COCKPIT CHECK.

2. INSTRUMENT TAKE-OFF.

Have student make instrument take-off and fly vertical "S" to working area, using those combinations of instruments on which he has shown the greatest weakness. When working area has been reached, take control of the aircraft and demonstrate the various magnetic compass errors. Supplement each demonstration by explanation over the interphone.

3. DEMONSTRATION OF NORTHERLY TURNING ERROR.

a. Place the aircraft on a magnetic heading of north and fly a straight course for a few seconds until the compass has "settled down." Then roll the aircraft into a bank and start a turn to the west. The compass will indicate immediately a turn to the right; i.e., toward east. Return to straight flight on a heading of north and repeat the demonstration; however, this time start a turn to the east, and point out that the compass will indicate a turn to the west. Demonstrate also that if a turn is started from a northerly heading and the rate of such turn is slow, the compass will indicate that a straight course is being maintained.

b. Review the above demonstration, and point out that when turning an aircraft from a northerly heading, the compass will indicate a turn is being made in the opposite direction; and that if the rate of turn is slow, no indication of turning may be shown by the instrument.

4. DEMONSTRATION OF SOUTHERLY TURNING ERROR.

This error is equal in magnitude to that of the northerly turning error. However, unlike the northerly error, the rate of turn on southerly headings seemingly *in-*

creases. This is true because the compass will indicate a turn is being made in the proper direction but at a much faster rate. Demonstrate this by turning to a heading of south and start a turn toward east or west. Point out the resulting indications.

5. DEMONSTRATION OF ACCELERATION AND DECELERATION ERROR.

a. Fly the aircraft on a heading of west. Then, by either raising the nose to decrease the air speed or by cutting the throttle, have student observe that deceleration on a heading of west will result in a compass indication of a turn to the south. Repeat this on a heading of east and notice that the compass will again indicate a turn to the south. *Acceleration* of the aircraft on a heading of east or west will result in an indicated turn to the north.

b. Explain that because of these errors of indications, to set accurately the directional gyro with the magnetic compass, flight must be straight and level in comparatively smooth air.

6. DEMONSTRATION OF TURNS TO HEADINGS BY USE OF COMPASS AND TURN NEEDLE.

a. To make successful turns to compass headings by use of the compass and turn needle alone, the angle of bank should not exceed 18°; the rate of turn must be no more than standard rate. When turning from east or west to a heading of north, the roll out should be started when the compass indicates a turn 35° to 40° *short* of north. When turning to a heading of south, the reverse is true, and the roll out should be started when the compass indicates a turn 20° to 25° *beyond* south. In other words, *undershoot* on north, *overshoot* on south.

b. There is no turning error on headings of east and west, and if the rate of turn and angle of bank do not exceed the aforementioned limits, the compass will work almost like a directional gyro. A turn to either of these headings should be stopped when the compass indicates the desired heading.

7. DEMONSTRATION OF PATTERN "A."

a. The instructor will first fly the pattern by making timed turns with no reference to the magnetic compass. Then, demonstrate the pattern by using the magnetic compass to make the turns. As the turns are made, explain the procedure used to roll out on a correct heading. Instruct the student that if, after rolling out of a turn, the heading is not correct, it will be necessary to make a small turn to place the aircraft on the desired heading. To make such short turns, instruct him to use a turn of one-third needle width, allowing one second for each degree of correction necessary. If necessary, demonstrate this procedure. As in regular timed turns, timing must begin the instant bank is applied and stopped when opposite bank is applied to roll out of the turn.

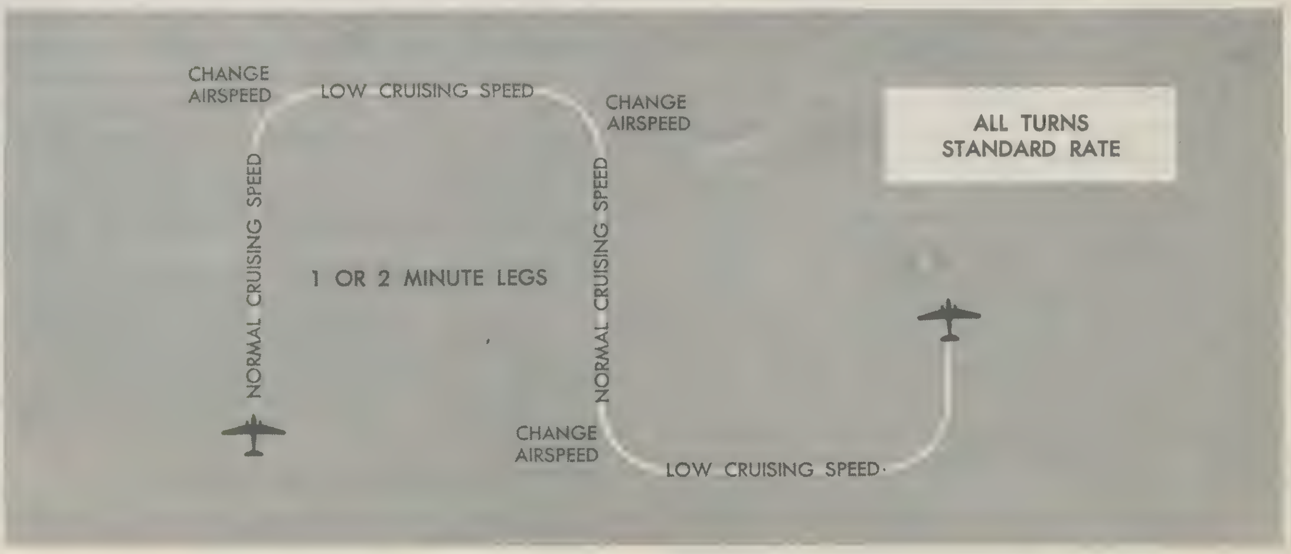
b. Student practices pattern "A," using: (1) flight indicator, turn needle, airspeed indicator, altimeter, and magnetic compass; (2) turn needle, airspeed indicator, altimeter, and clock. (When using this combination of instruments the magnetic compass will be used *only* to determine accuracy of turn after it is completed.)

8. CONSTANT RATE DESCENT.

Student practices constant rate descent to field.

9. LAND AND HOLD CRITIQUE.

NOTE: The amounts of lead and lag in the magnetic compass will vary with the latitude in which the aircraft is flying. In the higher latitudes the amounts of lead and lag will be increased. In the lower latitudes they will be decreased. The figures, as given in lesson VII, are applicable only when flight is conducted in latitudes close to 30°.



Pattern "A"

LESSON VIII

I OBJECTIVE

To teach change of air speed in turns. To introduce vertical "S" 1, and to review previous material.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Review previous lessons.
2. Explain proper method of changing air speed in turns.
3. Explain vertical "S" 1.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.
2. Student makes instrument take-off and flies vertical "S" to working area.
3. Demonstrate changing air speed in turns. Student practices changes of air speed in turns, using (1) flight indicator, airspeed, and altimeter; (2) turn needle, airspeed, and altimeter.
4. Demonstrate vertical "S" 1. Student practices vertical "S" 1 with (1) flight indicator, airspeed, altimeter, and vertical speed indicator; (2) turn needle, airspeed, altimeter, and vertical speed indicator.
5. Review previous material for the remainder of the period.
6. Vertical "S" 1 to field.
7. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. REVIEW.

Discuss weak points of material previously covered.

2. EXPLANATION OF CHANGES OF AIR SPEED IN TURNS.

a. When changing air speed in a standard rate turn, the variable components are pitch, bank, and power. As the air speed is increased or decreased to maintain a standard rate turn, bank attitude must be changed.

b. This exercise, in addition to increasing student proficiency in the three components of control, affords practice that will benefit the student when he is required to fly pattern "B." Have the student practice those changes of air speed in turns as will be required in pattern "B."

c. The procedure for changing air speed in turns is exactly the same as when changing air speed in straight flight. To decrease air speed in a turn, power is reduced to a value that will result in the desired air speed. As the airspeed falls off, the nose is raised to prevent loss of altitude. To increase airspeed in a turn power is applied, and as the air speed builds up the nose must be lowered to prevent an increase in altitude.

3. EXPLANATION OF VERTICAL "S" 1.

a. This maneuver is similar to the vertical "S." The wings will be held in a constant bank instead of being level as in vertical "S." The bank should be one that will result in a standard rate turn, and will be reversed after every other descent. Air speed must remain constant, and all climbs and descents should be at a given rate. When properly executed, this maneuver should create confidence in the student as to his ability. All the components of control (pitch, bank and power) are brought into prominence, and the student must make special effort to increase his speed of instrument coverage. The instructor will stress the necessity of a constant bank and proper control of the pitch attitude to maintain a constant air speed.

b. When demonstrating and explaining this maneuver, keep in mind the similarity of vertical "S" 1 and climbs and descents to predetermined headings and altitudes. Observe closely the rate of turn and rate of ascent or descent. Proficiency in this maneuver will greatly simplify lesson X, hence make special effort to have the student perform this maneuver as accurately as possible.

B. LESSON IN THE AIRCRAFT

1. COCKPIT CHECK.

2. INSTRUMENT TAKE-OFF.

3. DEMONSTRATION OF CHANGING AIR SPEED IN A TURN.

a. Establish a normal turn and demonstrate how to increase or decrease air speed in a turn. Be sure that the demonstration coincides with the pre-flight explanation, and emphasize the similarity of procedures in this maneuver and those used when changing air speed in straight and level flight. Again, review the necessity for changes in pitch attitude that must accompany all changes of power. *Remember the importance of trim.*

b. Student practices change of air speed in turns, using airspeed values as required by pattern B and (1) flight indicator, airspeed indicator, and altimeter; and (2) turn needle, airspeed indicator, and altimeter.

4. DEMONSTRATION OF VERTICAL "S" 1.

Demonstrate the procedure as covered in the instruction before take-off. Then student practices vertical "S" 2, using: (1) flight indicator, airspeed indicator, altimeter, and vertical speed indicator; (2) turn needle, airspeed indicator, altimeter, and vertical speed indicator.

5. REVIEW PREVIOUS MATERIAL.

6. VERTICAL "S" 1 TO FIELD.

7. LAND AND HOLD CRITIQUE.

LESSON IX

I OBJECTIVE

To teach pattern "B."

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Explain pattern "B."

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.
2. Student makes instrument take-off and flies vertical "S" and "S" 1 to working area.
3. Student flies pattern "B" on (1) flight indicator; (2) directional gyro, turn needle, airspeed indicator, and altimeter.
4. Vertical "S" and "S" 1 descent to field.
5. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. EXPLANATION OF PATTERN "B."

a. Pattern "B" is designed to give the student practice on most of the maneuvers covered thus far, and to teach him to plan ahead. As the pattern contains no new maneuvers, the only ground instruction necessary will be to review the sequence of maneuvers, turns, and timing that make up the pattern. Make sure that the student has a good picture of the pattern before attempting to fly it. Check this understanding by having him recite the pattern sequence and discuss each maneuver in turn.

B. LESSON IN THE AIRCRAFT

1. COCKPIT CHECK OF ALL FLIGHT INSTRUMENTS.

2. INSTRUMENT TAKE-OFF.

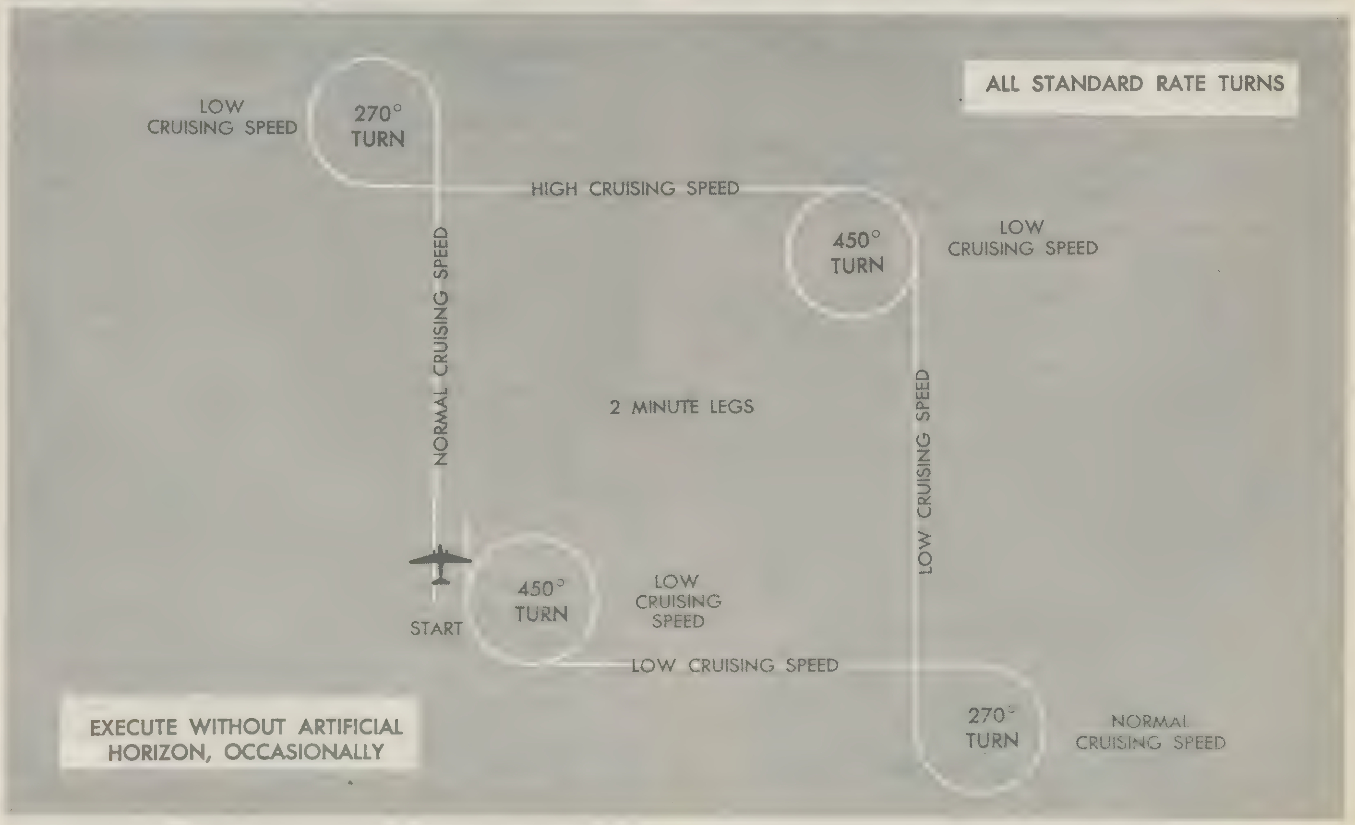
Student makes instrument take-off and flies vertical "S" and "S" 1 to working area, using the combinations of instruments on which he has shown the greatest weakness.

3. PATTERN "B."

Do not demonstrate this pattern unless absolutely necessary. Simply have student practice pattern "B," using the following combinations of instruments: (1) flight indicator, directional gyro, turn needle, airspeed indicator, and altimeter; (2) directional gyro, turn needle, airspeed indicator, and altimeter.

4. VERTICAL "S" AND "S" 1 DESCENT TO FIELD.

5. LAND AND HOLD CRITIQUE.



Pattern "B"

LESSON X

I OBJECTIVE

To teach climbs and descents to predetermined headings and altitudes. To teach recovery from unusual attitudes.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Discuss weak points of previous lesson.

2. Explain procedure used in making climbs and descents to predetermined headings and altitudes.

3. Explain unusual attitudes; how they occur and method of recovery.

a. Show how they occur.

b. Explain method of recovery.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Student makes instrument take-off and flies vertical "S" 1 to working area.

3. Review weak points of previous lesson as needed.

4. Demonstrate climbs and descents to predetermined headings and altitudes.

a. Student practices climbing and descending turns to predetermined headings, using: (1) flight indicator, directional gyro, turn needle, airspeed indicator, altimeter, and vertical speed indicator; (2) directional gyro, turn needle, airspeed indicator, altimeter, and vertical speed indicator.

5. Demonstrate recovery from unusual attitudes.

6. Student practices recoveries from the following unusual attitudes, returning to original headings and altitudes, using instruments that would normally remain in operation during such maneuvers:

a. Diving spiral.

b. Top of wing-over where air speed will build up.

c. Start of wing-over with nose-high attitude.

d. High air speed, nose-high spiral.

e. Stalls, spins (if aircraft permits).

f. Any other *reasonable* attitudes the instructor deems necessary.

7. Student makes vertical "S" or "S" 1 to field.

8. Land and hold critique.

III INSTRUCTOR'S GUIDE

A. BEFORE TAKE-OFF

1. REVIEW.

2. EXPLANATION OF CLIMBS AND DESCENTS TO PREDETERMINED HEADINGS AND ALTITUDES.

a. Climbs or descents to predetermined headings are maneuvers that require thought, skill, and quick, accurate instrument observation. Proper instruction can do a great deal to assure student success. Make every effort to affect student understanding, both before flight and while in the air. Convince the student that this maneuver incorporates nothing that he has not already learned. The only requirements are ability to make a timed turn, and at the same time, accomplish a climb or descent at a given rate. *Accuracy is expected,* and it will be necessary that the altimeter and the rate of climb be cross checked and their *combined* indications cross checked with those of the clock, rate of turn, and amount of turn completed.

b. A practical example of this maneuver is as follows: If a pilot were flying on a heading of 180° at 3000 feet and wished to turn to a heading of 360° and fly at 3500 feet, he would make a standard rate turn, climb at 500 feet per minute and reach the 360° heading and 3500 feet of altitude at the same time.

3. EXPLANATION OF RECOVERY FROM UNUSUAL ATTITUDES.

a. An unusual attitude is any attitude of the aircraft not required for normal instrument flight. The severity of the unusual attitude is determined by the amount of deviation from normal flight. Explain that an unusual attitude may result from the pilot's carelessness or confusion brought about by one or a combination of several factors. The factors that occur most commonly are: instrument failure, turbulence, or failure to cross check instruments.

b. Recovery from unusual attitudes is easily accomplished by following these simple rules:

(1) *Look at the airspeed indicator immediately upon detecting an unusual attitude of flight.*

(2) *If the air speed is too high,* first reduce power, then correct the banking attitude, and finally correct the pitch attitude.

(3) *If the air speed is too low,* increase power, correct pitch attitude to increase air speed, and then make any necessary corrections of bank attitude.

c. After initial corrective action has been taken, the problem of resuming normal flight attitude will still exist. The directional gyro and flight indicator will most likely be inoperative. This will require control of pitch attitude by use of the air speed and altimeter. The following principles of control must be applied:

(1) If the air speed is high, exert back pressure until the air speed begins to fall off and the altimeter stops indicating a descent. The aircraft is then in approximate level flight attitude. Back pressure must be immediately released to avoid a nose-high attitude.

(2) If the air speed is low, the above procedure will again apply. However, in this case, stop the decrease of air speed and increase of altitude by forward pressure. Release this pressure upon observing an increase of air speed and the first indication of a loss of altitude.

d. Point out that because of the very nature of the occurrence of an unusual attitude and the accompanying surprise to the pilot, corrective action must be instantaneous. Speed in recovery is essential. Excessive loss of altitude is undesirable. Repeat the above rules and make sure that the student will, regardless of his mental attitude, *instinctively* and *mechanically* use them any time he finds himself in an unusual attitude.

B. *LESSON IN THE AIRCRAFT*

1. COCKPIT CHECK.

2. INSTRUMENT TAKE-OFF.

Student makes instrument take-off and flies vertical "S" 1 to working area.

3. REVIEW.

Review weak points of previous lesson if necessary.

4. DEMONSTRATION OF CLIMBS AND DESCENTS TO PREDETERMINED HEADINGS AND ALTITUDES.

a. Instructor executes a 360° turn and climbs 1000 feet. When entering the climb, raise the nose to the climbing attitude (this should be done slowly to keep the initial rate of climb at approximately the desired rate) and simultaneously start a standard rate turn. As the air speed approaches the climbing figure, apply power to obtain or maintain the correct rate of climb. Then continue the maneuver, making any necessary corrections in bank attitude or vertical speed so that the aircraft will arrive at the desired heading and altitude simultaneously at the end of the two minutes of flight.

> **NOTE:** The type of aircraft used may sometimes limit the rate of climb to a figure less than 500 feet per minute. In this case, a turn of 360° and a climb of 500 feet at a rate of 250 feet per minute will be used for demonstration.

b. Demonstrate a descent to a predetermined heading and altitude by descending 1000 feet while executing a 360° turn. The same procedures used in the climb will be used in this instance.

c. Student practices climbing and descending turns to predetermined headings and altitudes, using: (1) flight indicator, directional gyro, turn needle, airspeed indicator, altimeter, and vertical speed indicator; (2) directional gyro, turn needle, airspeed indicator, altimeter, and vertical speed indicator.

5. DEMONSTRATION OF RECOVERY FROM UNUSUAL ATTITUDES.

a. Instructor will use same procedure as explained in before take-off. Recovery from stalls will be made exactly as in contact flight (power off, power on, etc.). When demonstrating these methods, it is advisable to start making slow recoveries from the unusual attitude. Point out how each correction is made in sequence. Then demonstrate how such corrections may be used almost simultaneously to affect a faster recovery.

b. In recovery from spins, the mechanical procedure used in contact flight will be used to stop the spin. After the spin has been broken, bring the aircraft back to desired condition of flight, just as if recovering from an extremely nose-low attitude.

c. In recovery from *all* unusual attitudes, a climb or descent back to the original altitude will begin as soon as a safe air speed has been attained. *Do not wait until cruising air speed has been attained.*

6. STUDENT PRACTICE OF RECOVERIES.

Student practices recoveries from unusual attitudes, returning to original headings and altitudes, using instruments that would normally remain in operation during such maneuvers. Have the student recover from the following unusual attitudes:

a. Diving spiral.

b. Top of wing-over where air speed will build up.

c. Start of wing-over with nose-high attitude.

d. High air speed, nose-high spiral.

e. Stalls, spins (if aircraft permits).

f. Any other *reasonable* attitudes the instructor deems necessary.

7. VERTICAL "S" OR "S" 1 TO FIELD.

8. LAND AND HOLD CRITIQUE.

LESSON XI

I OBJECTIVE

To review all basic work in preparation for the basic check.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Discuss any points in the basic course which are not clear to the student.

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Instrument take-off.

3. Climbing turns to working area, using combinations of instruments on which the student has shown the greatest weakness.

4. Pattern "A." Student uses turn needle, airspeed indicator, altimeter, and magnetic compass.

5. Pattern "B." Student uses combination of instruments on which he has shown the greatest weakness.

6. Student practices recoveries from unusual attitudes to predetermined headings. (Have the student make recoveries as outlined in lesson X.)

7. Descending and climbing turns to predetermined headings and altitudes, using instruments on which he has shown the greatest weakness.

8. Land and hold critique.

III INSTRUCTOR'S GUIDE

This lesson is set aside, as lesson V was, to increase the student's proficiency on those maneuvers and instrument combinations on which he has displayed the greatest weakness. It is not intended to "cram" the student so that he may pass the basic check in lesson XII; its purpose is to provide extra instructional time to "polish" any rough spots in the student's technique.

The preceding lessons should have given the student a thorough understanding of the principles of instrument flight and the ability to interpret instrument readings quickly and accurately. In addition, his control technique should be satisfactory. However, it is likely that some maneuvers and phases of control require extra attention, and during the review these weaknesses should become apparent.

Follow the lesson sequence as outlined. Do not spend time on maneuvers the student has mastered; cover those which cause trouble. Pay special attention not only to the maneuver, but also to the principle of control involved, whether pitch, bank, or power. Stress the smooth exercise of control and proper use of trim.

LESSON XII—BASIC CHECK

I OBJECTIVE

To check the knowledge and ability of the student in basic instrument flying.

II LESSON OUTLINE

A. BEFORE TAKE-OFF

1. Question student on the different phases of basic instrument flying. (His answer will determine his grade under general knowledge of the subject.)

B. LESSON IN THE AIRCRAFT

1. Cockpit check of all flight instruments.

2. Instrument take-off.

3. Climbing turns to given headings and altitudes, using flight indicator, directional gyro, turn needle, airspeed indicator, altimeter, and vertical speed indicator.

4. Steep turns, using: (1) flight indicator, directional gyro, airspeed indicator, and altimeter; (2) turn needle, airspeed indicator, and altimeter.

5. Pattern "B," using all instruments available.

6. Pattern "A," using turn needle, airspeed indicator, altimeter, magnetic compass, and clock.

7. Recovery from following unusual attitudes to original heading and altitude. (Instruments that would normally remain in operation during these maneuvers will be used for recovery.)
   a. Stalls (in turns, power on, power off, etc.)
   b. Diving spirals (in excess of 60° bank).
   c. Spins (if permitted in type of aircraft being flown).

8. Descents to given headings and altitudes, using directional gyro, turn needle, airspeed indicator, altimeter, and vertical speed indicator.

9. Land and hold critique.

III GUIDE FOR BASIC CHECK PILOTS

This check will be conducted as outlined. All maneuvers will be completed and a ground interrogation held before any decision is made as to the student's grade.

When checking student's knowledge before take-off, ask direct questions. Put the questions in such a way that the student, in answering, must explain both flight procedure and the reasons that such procedure is used.

For example, ask the student to explain the components of control used to change air speed in level flight. His answer should include a description of the control technique used and in addition, an explanation of power and pitch. He should tell why a change in pitch attitude is necessary as the air speed is reduced, and why additional power may have to be added during the turn. Such questions should reveal the student's understanding of the principles of control of instrument flight, and little difficulty should be met in determining the student's grade on this phase of the basic check.

On the other hand, the flight check presents a more difficult problem. In determining whether to fail or pass the student, the check pilot must take the following three factors into consideration: (1) proper control of power, pitch, and bank when executing maneuvers; (2) correct and smooth technique; and (3) accuracy of flight within limits. All three must be satisfactory.

It is not difficult to evaluate the student's control technique and the proper use of power, pitch, and bank. Limits, however, present a difficult and sometimes complicated problem. It is the responsibility of the check pilot to determine whether strict adherence to limits will be a decisive factor in grading the student. Momentary exceeding of limits should not be sufficient reason for failing the student, provided the condition is quickly and properly corrected. In such cases, proper corrective action can be considered in the student's favor. However, repeated failure to stay within desired limits is unsatisfactory.

Conscientious effort and sensible, impersonal grading by the check pilot are far more important than any standards this Technical Order could direct.